

Rocky Flats Environmental Technology Site

PRO-475-RSP-16 01

Revision 1

Radiological Survey/Sampling Package Design, Preparation, Control, Implementation and Closure

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KH Radiological Engineering	776/777 Closure Project
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RADIOLOGICAL SURVEY/SAMPLING
PACKAGE DESIGN, PREPARATION,
CONTROL, IMPLEMENTATION
AND CLOSURE

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PRO-475-RSP-16 01
REVISION 1
PAGE 2

LIST OF EFFECTIVE PAGES

<u>Pages</u>	<u>Effective Date</u>	<u>Pages</u>	<u>Effective Date</u>
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TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
TITLE PAGE	1
LIST OF EFFECTIVE PAGES	2
TABLE OF CONTENTS	3
1 PURPOSE	5
2 SCOPE	5
3 RESPONSIBILITIES	5
3 1 Change Initiator/Procedure User	5
3 2 RE Reviewer	5
3 3 Radiological Control Technician Technical Supervision	5
3 4 Radiological Control Technician	5
3 5 Radiological Engineering Manager or Radiological Safety Manager (RSM)	6
3 6 Radiological Engineer	6
4 GLOSSARY	7
4 1 Acronyms	7
4 2 Definitions	7
5 LIMITATIONS AND PRECAUTIONS	10
6 PREREQUISITE ACTIONS	10
7 INSTRUCTIONS	12
7 1 General	12
7 2 Survey Area/Unit Designation	12
7 3 Survey Unit Classification (FSS Only)	13
7 4 Reconnaissance Level Characterization Survey/Sample Design	13
7 4 1 General	13
7 4 2 Survey/Sample Design	14
7 4 3 Conducting Surveys/Samples	14
7 4 4 Evaluating Survey/Sample Results	16
7 4 5 Documentation	16
7 5 Final Status Survey/Sample Design	16
7 5 1 General	16
7 5 2 Determining Numbers of Data Points	17
7 5 3 Determining Survey/Sample Locations	19
7 5 4 Evaluating Survey/Sample Results	20
7 6 Quality Control Requirements (Required for FSS only)	20
7 7 Survey Instrumentation Requirements (Required for FSS only)	20

TABLE OF CONTENTS (continued)

7 8	Survey/Sample Package Preparation	20
7 9	Survey/Sample Package Release	22
7 10	Survey/Sample Package Implementation	23
7 11	Survey/Sample Data Review	24
7 12	Additional Survey Requirements	24
7 13	Survey/Sample Package Validation, Data Quality Analysis and Closure	27
7 14	Survey/Sample Package Administrative/Technical Change Process	29
7 14.1	Administrative Changes	29
7 14.2	Technical Changes	30
8	POST-PERFORMANCE ACTIVITY	32
9	RECORDS PROCESSING INSTRUCTIONS	33
10	REFERENCES	33

APPENDICES

Appendix 1, Survey Package Cover Sheet	35
Appendix 2, Survey Package Sign-Out Form	36
Appendix 3, Survey Unit Breakdown Form	37
Appendix 4, Survey Package Tracking Form	38
Appendix 5, Default Calculation Worksheets	39
Appendix 6, Survey Package Calculation Worksheet	42
Appendix 7, Survey Package Survey/Sampling Instructions Form	43
Appendix 8, Survey Package Correction/Change History Form	45

TABLES

Table 1, RLC Survey/Sample Requirements	15
Table 2, FSS Survey Unit Surface Area Guidelines	16
Table 3, Required Survey/Scan Frequencies	17
Table 4, Values of Sign p for Given Values of the Relative Shift, Δ/σ	18
Table 5, Impacted Class 1 and 2 Survey Unit Investigations	25
Table 6, Impacted Class 3 Survey Unit Investigations	26

1 PURPOSE

This procedure provides guidance for radiological survey/sampling package design, preparation, control, implementation and closure to perform Reconnaissance Level Characterization (RLC) and Final Status Surveys (FSS) for surfaces and structures at RFETS

2 SCOPE

This procedure applies to personnel who design develop, implement, collect, documents and evaluate data associated with RLC and FSS radiological survey/sampling packages

The forms attached to this procedure are examples that are used in documenting survey/sampling information, however, equivalent forms may be used in lieu of the attached forms (i e , appendices) as long as the information is equivalent to the minimum information required by the forms in this procedure

This revision supersedes PRO 475-RSP-16 01 Revision 0 and associated forms

3 RESPONSIBILITIES

3 1 Change Initiator/Procedure User

Reads, understands, and complies with the requirements of this procedure

3 2 RE Reviewer

Provides validation and verification of radiological sampling/survey data

3 3 Radiological Control Technician Technical Supervision (RCTTS)

Assigns radiological survey/sampling packages to Radiological Control Technicians (RCTs) for the performance of radiological surveys

Reviews all radiological survey/sampling package survey forms for accuracy and completeness prior to technical evaluation of data

3 4 Radiological Control Technician (RCT)

Performs and documents radiological surveys in accordance with instructions provided in accordance with this procedure PRO-476-RSP-16 02 Pre-Demolition (Final Status) Surveys of Surfaces and Structures, PRO-476-RSP-16 03 Radiological Samples of Building Media, and 3-PRO-165-RSP-07 02 Contamination Monitoring Requirements, for Reconnaissance Level Characterization surveys

Provides initial review and signature of collected data

Provides complete, accurate and legible documentation.

Notifies the Radiological Control Technical Supervisor of any out-of-tolerance or suspect radiological condition

3.5 Radiological Engineering Manager or Radiological Safety Manager (RSM)

Reviews and signs the Survey Package Cover Sheet (see Appendix 1) indicating that the radiological survey/sampling package is ready for closure

Assigns Radiological Engineer (RE) to review radiological survey/sampling packages.

3.6 Radiological Engineer

Responsible for sub-dividing facility floor plans into survey areas and survey units

Prepares radiological survey/sampling packages

Determines the number of sample measurement locations.

Signs the Survey Package Cover Sheet indicating that the radiological survey/sampling package is ready for implementation.

Provides technical guidance and oversight during radiological survey/sampling package implementation

Ensures that radiological survey/sampling packages are issued and tracked during collection of data.

Determines if a replacement, investigation, remediation or other type of survey for a survey unit is required

Approves technical corrections/changes to the radiological survey/sampling package.

Reviews and signs the Survey Package Cover Sheet (see Appendix 1) indicating that the radiological survey/sampling package is ready for closure

Reviews and validates closed radiological survey/sampling packages.

Performs data analysis of radiological survey results

Prepares reports (RLC and/or PDS/FSS)

4 GLOSSARY

4.1 Acronyms

ASD	Analytical Services Division
cpm	Counts Per Minute
D&D	Decontamination and Decommissioning
DCGL _w	Derived Concentration Guideline Level-Wilcoxon Rank Sum test
DCGL _{EMC}	Derived Concentration Guideline Level-Elevated Measurement Comparison
DOE	U S Department of Energy
dpm	Disintegration Per Minute
DQA	Data Quality Assessment
DQO	Data Quality Objectives
EPA	U S Environmental Protection Agency
FDPM	Facility Disposition Program Manual
FSS	Final Status Survey (Analogous to Pre-Demolition Survey)
FSSP	Final Status Survey Plan [Analogous to Pre-Demolition Survey Plan (PDSP)]
FSSR	Final Status Survey Report (Analogous to Pre-Demolition Survey Report)
HSA	Historical Site Assessment
IPC	In-Process Characterization
LBGR	Lower Bound of the Gray Region
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
NORM	Naturally Occurring Radioactive Material
QA/QC	Quality Assurance/Quality Control
RCT	Radiological Control Technician
RCTTS	Radiological Control Technician Technical Supervision
RE	Radiological Engineer
REM	Radiological Engineering Manager
RFETS	Rocky Flats Environmental Technology Site
RLC	Reconnaissance Level Characterization
RLCP	Reconnaissance Level Characterization Plan
RLCR	Reconnaissance Level Characterization Report
RSM	Radiological Safety Manager
V&V	Verification and Validation

4.2 Definitions

DCGL_w – Derived Concentration Guideline Level - Contamination limit based on the assumption that the concentration of residual activity is evenly distributed over a large area

DCGL_{EMC} – Derived Concentration Guideline Level - Contamination limit based on the assumption that the concentration of residual activity is distributed as small-elevated areas within a larger area

Data Quality Objectives (DQOs) – DQOs are qualitative and quantitative statements derived from the DQO process that clarify technical and quality objectives, define the appropriate type of data, and specify levels of decision error that will be used as the basis for establishing the quality and quantity of data necessary to support facility disposition decisions.

Facility – Any equipment, structure, system, process, or activity that fulfills a specific purpose. The definition of facility most often refers to buildings and other structures, their functional systems and equipment, and other fixed systems and equipment installed therein to delineate a facility. However, specific operations and processes independent of buildings or other structures (e.g., waste retrieval and processing, waste burial, remediation, groundwater or soil decontamination, decommissioning) are also encompassed by this definition. For the purpose of this procedure, facility is expanded to include any formally designated building, site, structure, area, or project where a formal work authorization must be granted prior to conducting work.

Final Status Survey (Analogous to Pre-Demolition Survey) – Radiological measurements, evaluations and support activities undertaken to demonstrate that a facility satisfies the criteria for unrestricted use.

Final Survey Report (Analogous to Pre-Demolition Survey Report) – A report describing the methods and results of the Final Survey. The Final Status Survey Report initiates the final review and inspection of a facility for unrestricted release.

Impacted Class 1 Areas – Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation surveys) above the DCGL. Examples of Class 1 areas include 1) site areas previously subjected to remedial actions, 2) locations where leaks or spills are known to have occurred, 3) former burial or disposal sites, 4) waste storage sites, and 5) areas with contaminants in discrete solid pieces of material and high specific activity.

Impacted Class 2 Areas – Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL. To justify changing the classification from Class 1 to Class 2, there should be measurement data that provides a high degree of confidence that no individual measurement would exceed the DCGL. Other justifications for reclassifying an area as Class 2 may be appropriate based on site-specific considerations. Examples of areas that might be classified as Class 2 for the final status survey include: 1) locations where radioactive materials were present in an unsealed form, 2) potentially contaminated transport routes, 3) areas downwind from stack release points, 4) upper walls and ceilings of buildings or rooms subjected to airborne radioactivity, 5) areas handling low concentrations of radioactive materials, and 6) areas on the perimeter of former contamination control areas.

Impacted Class 3 Areas – Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small

fraction of the DCGL_w, based on site operating history and previous radiation surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

Isolation Controls – Training, posting and physical access control measures implemented following Pre-Demolition Survey (PDS) designed to ensure that a given area's radiological characterization do not change. These isolation controls are applied in two levels as delineated in the Site Pre-Demolition Survey Plan.

Judgmental Survey (analogous to biased) – Surveys that are performed at locations selected using professional judgment based on unusual appearance, location relative to known contamination areas, high potential for residual radioactivity (e.g., horizontal surfaces, high traffic areas, corners, drains), general supplemental information, etc.

Local Area Background – Background survey instrument readings taken at specific locations within a survey unit in order to determine actual contamination values in a more precise manner.

Measurement Location – A survey location where a typical set of total surface contamination and removable contamination measurements are obtained.

Minimum Detectable Activity – The minimum amount of activity that can be statistically detected above background with a 95% probability and with a maximum of 5% probability of falsely interpreting sample activity due to background.

Non-Impacted Areas – All areas not classified as Impacted Class 1, Impacted Class 2 or Impacted Class 3. These areas are areas where there is no reasonable potential for residual contamination, based on knowledge of building history and/or previous survey information. Sufficient information is present to be assured that no residual contamination is present above the applicable contamination limits.

Remediation – Activities conducted to reduce potential risks to people and/or harm to the environment from radioactive and/or hazardous substance contamination.

Representative Survey – A survey that is designed to collect an appropriate number of measurements which will give an accurate representation of the conditions in a defined area.

Survey Area – The most general category, comprised of surfaces to be further defined as one or more survey units, the bounds of which are defined by existing physical features such as walls, columns, beams, etc.

Survey Design – The process of determining the type, location, number and density of radiological measurements to be taken for a RLC or final status survey.

Survey Instructions – Written instructions which specify the type and number of measurements to be taken in a survey area or survey unit. Each survey package shall include survey instructions

Survey Package – A collection of information in a standardized format for controlling and documenting field measurements taken for a RLC or final status survey. A survey package is prepared for each Survey Unit or Survey Area. The survey package typically includes the survey instructions, survey data sheets and grid maps

Survey Point – A smaller subdivision within an area or unit designated as a survey location where measurements are obtained. This area generally refers to the area covered by a detector probe or 100 cm² when a swipe is obtained.

Survey Unit – A contiguous area with similar characteristics and contamination potential. Survey units are established to facilitate the process and aid in the statistical evaluation of the survey data. As a general rule a survey unit is a subset of a survey area.

Type 1 Building – Building free of DOE controlled radioactive contamination

Type 2 Building – Buildings without significant DOE controlled radioactive contamination or hazards, but in need of decontamination

Type 3 Building – Buildings with significant DOE controlled radioactive contamination and/or hazards

5. LIMITATIONS AND PRECAUTIONS

Avoid damaging valuable or reusable surfaces when marking survey measurement locations. Non-permanent markers or self-adhesive labels may be used for surfaces that are deemed valuable or reusable

Some situations may require variations in the survey or sampling techniques detailed in the radiological survey/sampling package instructions. Permission from the Radiological Engineer is required in accordance with approved procedures, if available, to perform any deviations from radiological survey/sampling package instructions

6. PREREQUISITE ACTIONS

Procedure User

- [1] Ensure that the following occurs
 - Personnel developing radiological survey/sampling packages shall be trained with respect to the contents of this procedure.
 - Prior to performing radiological survey measurements, a radiological survey/sampling package shall be prepared for each applicable survey area or survey unit. The RE and an independent RE shall sign the Survey Package

Cover Sheet (see Appendix 1) indicating that the radiological survey/sampling package is ready for implementation

- All required decommissioning and housekeeping activities are completed and required isolation controls as delineated in the Site Pre-Demolition Survey Plan (PDSP) are established in the final status survey unit prior to the collection of survey data
- A Radiological Work Permit (RWP) will be obtained prior to survey/sampling package implementation for Reconnaissance Level Characterization, if appropriate
- The radiological survey/sampling package is ready for implementation including survey instructions regarding the location number, and type of survey/sampling measurements required
- Survey personnel have been trained in the use of the radiological survey/sampling package prior to the collection of survey data

7 INSTRUCTIONS

7.1 General

This procedure may be used to conduct Reconnaissance Level Characterization, or Class 1, Class 2 and Class 3 final status surveys, as applicable.

Due to the large amount of data to be recorded on radiological survey/sampling package forms and the small space available, it is imperative to print neatly on all forms. Where applicable, data and information may be entered on radiological survey/sampling package forms electronically.

A folder designated as the "Survey Package" should be used to keep original paperwork for each survey area or survey unit.

Initiated and implemented radiological survey/sampling packages should be stored in a designated file cabinet when not in use (e.g. at shift change, over night, during holidays and weekends, etc.).

Closed radiological survey/sampling packages removed from the cabinet should be logged out using Survey Package Sign-Out Form (see Appendix 2).

7.2 Survey Area/Unit Designation

NOTE *RLC areas will be broken down into survey areas only. FSS areas will be further broken down into survey units.*

RE

- [1] Verify the building type of the building or cluster of buildings to be surveyed as per MAN-076-FDPM, Facility Disposition Program Manual
- [2] Sub-divide the building or cluster of buildings into survey areas (RLC/FSS) and survey units (FSS)
 - [A] Refer to Table 1 for RLC and Tables 2 and 3 for FSS
- [3] **WHEN** designing survey areas/units,
THEN physical bounds should be identified to include structural walls, row and column designators, elevations or other features such as changes in floor surfaces
- [4] List all buildings for the designated cluster on Survey Unit Breakdown Form (see Appendix 3) to ensure all areas, surfaces and systems will be adequately addressed by the Final Status Survey. In addition, record the following information on Survey Package Tracking Form (see Appendix 4):
 - Survey Area.
 - Survey Unit.

This form should be completed prior to implementation of final survey for a specific cluster or area.

- [5] Perform a preliminary walkdown of the area to be surveyed prior to radiological survey/sampling package initiation to verify that housekeeping operational surveys etc are acceptable prior to commencing RLC or Final Status Surveys

7.3 Survey Unit Classification (FSS only)

RE

- [1] Identify and classify each survey unit

Examples of Class 1 units include

- Site areas previously subjected to remedial actions
- Locations where leaks or spills are known to have occurred
- Former burial or disposal sites
- Waste storage sites
- Areas with contaminants in discrete solid pieces of material with high specific activity

Examples of Class 2 units include

- Locations where radioactive materials were present in an unsealed form
- Potentially contaminated transport routes
- Areas downwind from stack release points
- Upper walls and ceilings of buildings or rooms subjected to airborne radioactivity
- Areas handling low concentrations of radioactive materials
- Areas on the perimeter of former contamination control areas

Examples of Class 3 units include

- Buffer zones around Class 1 or Class 2 areas
- Areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification

7.4 Reconnaissance Level Characterization Survey/Sample Design

7.4.1 General

RLC surveys, may satisfy any of the following objectives

- Determine the nature and extent of radiological contamination
- Evaluate remediation alternatives
- Estimate the occupational and public health and safety impacts during decommissioning
- Evaluate remediation technologies
- Input to final status survey design

7.4.2 Survey/Sample Design

The RLC survey identifies those portions of the facility that have been affected by site activities and are potentially contaminated. The survey also identifies the portions of the facility that have not been affected by these activities.

Additionally, RLC data is used to justify classification of survey units.

Radiological Engineers assigned to D & D Programs design RLC survey/sample requirements. The primary focus was to ensure that RLC survey/sample data qualitatively identified locations and magnitude of surface and structure contamination to further enable successful completion of FSS. The results of this committee design are provided in 7.4.3, Conducting Survey/Samples.

7.4.3 Conducting Surveys/Samples

Surveys of building surfaces and structures include surface scanning, surface activity measurements, and sample collection. Both field survey instrumentation and analytical laboratory equipment and procedures are selected based on their detection capabilities for the expected contaminants.

Measurement locations should be documented using reference system coordinates on a survey map. Maps are not required to be drawn to scale for RLC surveys.

Table 1, RLC Survey/Sample Requirements summarizes the site requirements for conducting RLC surveys.

TABLE 1
RLC Survey/Sample Requirements

Survey Area Description		Maximum Survey Area (m ²)	Surface Activity Measurements	Surface Scans	Media Sampling	Volumetric Sampling	Isotopic Gamma Scans
Non Contaminated Areas RBAs RMAs	Floors and walls below 2 meters	Up to 2000 m ² (based on floor area)	30 uniformly distributed locations plus biased at suspect location	1 m ² at each location judgmental scans at biased locations	Biased samples may be collected based on RE judgement	Biased samples may be collected based on RE judgement	Biased isotopic gamma scans may be collected based on RE judgement
	Ceilings and walls above 2 meters	Up to 2000 m ² (based on floor area)	10 at biased accessible locations	None required unless contamination is discovered Biased scanning may be performed based on RCT and RE judgement			
	Equipment	Up to 2000 m ² (based on floor area)	30 at biased accessible locations				
	Exterior walls and roofs	Each building	30 uniformly distributed locations plus biased at suspect location				
CAs FCAs	Floors and walls below 2 meters	Up to 1000 m ² (based on floor area)	30 uniformly distributed locations plus biased at suspect location	1 m ² at each location judgmental scans at biased locations	Biased samples may be collected based on RE judgement	Biased samples may be collected based on RE judgement	Biased isotopic gamma scans may be collected based on RE judgement
	Ceilings and walls above 2 meters	Up to 1000 m ² (based on floor area)	10 at biased accessible locations	None required unless contamination is discovered Biased scanning may be performed based on RCT and RE judgement			
	Equipment	Up to 1000 m ² (based on floor area)	30 at biased accessible locations				
	Exterior walls and roofs	Each building	30 uniformly distributed locations plus biased at suspect location				
HCAs ARAs		No surveys required					

7.4.4 Evaluating Survey/Sample Results

RLC data are used to identify locations and extent of residual activity. The survey results are then compared with DCGLs. Surfaces and media are differentiated as exceeding DCGLs, not exceeding DCGLs, or not contaminated, depending on the results relative to the DCGL value. Direct measurements indicating areas of elevated activity are further evaluated to determine the need for additional measurements.

7.4.5 Documentation

Documentation of the RLC survey should provide a complete and unambiguous record of the radiological status of the survey area. Sufficient data and information should be provided to enable an independent re-creation and evaluation. To the extent practicable, this data package should be a stand-alone document with minimum information incorporated by reference. The package will be independently reviewed by organizations other than Radiological Engineering. Sufficient information to characterize the extent of contamination, including affected media, should be provided in the RLC report.

7.5 Final Status Survey/Sample Design

7.5.1 General

A final status survey is performed to demonstrate that residual radioactivity in each survey unit satisfies the predetermined criteria for release for unrestricted use or, where appropriate, for use with designated limitations. The survey provides data to demonstrate that all radiological parameters do not exceed the established DCGLs. Table 2, FSS Survey Unit Surface Area Guidelines summarizes the site guidance for survey unit size.

Table 2
FSS Survey Unit Surface Area Guidelines

Classification	Survey Unit Surface Area ⁽¹⁾
Class 1	Up to 100 m ² floor area
Class 2	100 to 1000 m ² floor area
Class 3	No Limit

(1) These size restrictions are guidelines. Larger floor surface areas may be utilized if additional measurements are collected (i.e., increase number of samples (N) by the following: $N = \text{Calculated required number of measurements} * ((\text{Actual Surface Area})/(\text{Table 2 Size Limit}))$)

7 5 2 Determining Numbers of Data Points

NOTE *Default values are to be utilized if specific parameters have not been previously determined Table 3 Required Survey/Scan Frequencies provides the minimum number of measurements based on default values Appendix 5 Default Calculation Work Sheets is referred to for details on default calculations*

Table 3
Required Survey/Scan Frequencies

Classification	Surface Scan Coverage	Minimum Number of Measurements ⁽¹⁾⁽²⁾	
Class 1	100% of Accessible Surfaces	Total Surface Activity	15
		Removable	15
		Samples	15
Class 2	10 to 100% Floors/Lower Walls 10 to 50% Upper Walls/Ceiling (Systematic and Judgmental) ⁴	Total Surface Activity	15
		Removable	15
		Samples	15
Class 3	Biased (Judgmental) ⁵	Total Surface Activity	15
		Removable	15
		Samples	N/A ⁽³⁾

- (1) The minimum number of measurements are based on the default coefficient of variation (CV) values recommended by MARSSIM Actual characterization data may be utilized to calculate the required number of measurements by following the calculation guidance provided on the worksheets utilizing the ACTUAL expected survey/sample standard deviation
- (2) Surface media samples (i.e. paint samples) are not required in areas where surface media has been removed (e.g. scabbled or hydrolazed areas) and are not required where surface media is not a suspect matrix (per RLC data)
- (3) Surface media samples are typically not required for Class 3 survey units
- (4) Ceiling is analogous to the roof for exterior survey units
- (5) Biased (judgemental) scans should include high traffic areas such as building entrance and exits and hallways HVAC intakes and exhaust ducts storage areas areas of frequent personnel contacts such as doors and door frames and horizontal surfaces

NOTE *Survey Package Calculation Worksheet (see Appendix 6) does not need to be completed if the default number of measurements per Table 3 above is used*

RE

- [1] Record the following information on Survey Package Calculation Worksheet (see Appendix 6)
- Building
 - Survey Area
 - Survey Unit

- Survey Unit Description
- Survey Type – Total Surface Activity, Removable Surface Activity, or Media Surface Activity

NOTE *The value for relative shift should be between 1 and 3. Anything less than 1 will result in a large number of measurements needed to demonstrate compliance.*

- [2] Calculate the Relative Shift, Δ/σ , = $(DCGL-LBGR)/\sigma$,

σ , is the standard deviation of previous surveys in the survey unit, or a 30% coefficient of variation may be used to estimate the standard deviation for the type of measurement to be obtained

- [3] Determine Sign p using the calculated relative shift and the following table

TABLE 4
Values of Sign p for Given Values of the Relative Shift, Δ/σ

Δ/σ	Sign p	Δ/σ	Sign p
0.1	0.539828	1.2	0.884930
0.2	0.579260	1.3	0.903199
0.3	0.617911	1.4	0.919243
0.4	0.655422	1.5	0.933193
0.5	0.691462	1.6	0.945201
0.6	0.725747	1.7	0.955435
0.7	0.758036	1.8	0.964070
0.8	0.788145	1.9	0.971284
0.9	0.815940	2.0	0.977250
1.0	0.841345	2.5	0.993790
1.1	0.864334	3.0	0.998650

If $\Delta/\sigma > 3.0$, use Sign p = 1.000000

- [4] Determine Decision Error Percentiles for $Z_{1-\alpha}$ and $Z_{1-\beta}$.

Typical (α) and (β) values used at RFETS are 0.05 and 0.05 respectively. This yields a $Z_{1-\alpha}$ and $Z_{1-\beta}$ value of 1.645 and 1.645 respectively.

- [5] Calculate Number of Data Points (N) for Sign p test using the following equation.

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(\text{Sign } p - 0.5)^2} \quad \text{Eq 1}$$

- [6] Increase the number of data points by 20% to ensure sufficient power of the tests and to allow for possible data losses.

7 5 3 Determining Survey/Sample Locations

NOTE Steps [1] through [5] are specific to determining survey/sample locations for Class 1 or 2 survey units While Steps [6] through [9] are specific to Class 3 survey units

RE

[1] **IF** determining survey/sample locations for Class 1 or Class 2 survey units
THEN obtain a scale drawing of the survey unit with an overlying grid system

[2] Select a random-start systematic pattern

The number of calculated survey locations n , based on the statistical tests, is used to determine the spacing, L , of a systematic pattern by

$$L = \sqrt{\frac{A}{0.866 n}} \quad \text{for a triangular grid} \quad \text{Eq 2}$$

$$L = \sqrt{\frac{A}{n}} \quad \text{for a square grid} \quad \text{Eq 3}$$

where A is the area of the survey unit

[3] After L is determined, generate a random starting coordinate utilizing Excel or other random number generator

Beginning at the random starting coordinate, a row of points is identified, parallel to the X-axis, at intervals of L

[4] For a triangular grid a second row of points is then developed, parallel to the first row, at a distance of $0.866 \times L$ from the first row

Survey points along that second row are midway (on the X-axis) between the points on the first row This process is repeated to identify a pattern of survey locations throughout the affected survey unit

[5] **IF** identified points fall outside the survey unit,
OR locations cannot be surveyed
THEN additional points are determined using the random process until the desired total number of points is identified

[6] **IF** determining survey/sample locations for Class 3 survey units
THEN obtain a scale drawing of the survey unit with an overlying grid system

- [7] Generate random survey locations utilizing Excel or other random number generator
- [8] Locate desired number of data points using random numbers.
- [9] IF identified points fall outside the survey unit,
OR locations cannot be surveyed,
THEN additional points are determined using the random process until the desired total number of points is identified

7.5.4 Evaluating Survey/Sample Results

Final status survey data will be analyzed in accordance with PRO-478-RSP-16 04, Radiological Survey/Sample Data Quality Analysis for Final Status Survey

7.6 Quality Control Requirements (Required for FSS only)

Final status survey quality control requirements will be in accordance with PRO-479-RSP-16 05, Radiological Survey/Sample Quality Control for Final Status Survey

7.7 Survey Instrumentation Requirements (Required for FSS only)

Survey instrumentation requirements for radiological surveys of surfaces and structures can be found in Procedure PRO-476-RSP-16 02, Pre-Demolition (Final Status) Surveys of Surfaces and Structures. This procedure identifies survey type, radiation type and instrumentation requirements.

Instrumentation requirements for media sampling can be found in Procedure PRO-477-RSP-16 03, Radiological Samples of Building Media. This procedure identifies sample type, radiation type and instrumentation requirements

7.8 Survey/Sample Package Preparation

RE

- [1] Ensure the following information is recorded on Survey Package Sign-Out Form (see Appendix 2)
 - Survey Area – This is an alphanumeric designation commencing with the letter A. If the survey area values exceed the letter Z, continue with AA, BB and so on
 - Survey Unit – This value is in the form of building number, followed by the survey area value and survey unit sequential values starting with 001 (Example 729001, 729002, etc.). If the survey unit is not defined (e.g. RLC Survey) enter N/A.
 - Building/Structure – Building number

-
- [2] Record the following information on Survey Unit Breakdown Form (see Appendix 3)
- Survey Area
 - Survey Unit
 - Building/Structure – Building number
 - Description – Provide a brief description of the survey unit or survey area. In the event that the survey unit is not defined (e.g. RLC Survey), enter N/A
- [3] Retain Survey Unit Breakdown Form on file in project files to track survey units assigned
- [4] Enter the following information on Survey Package Cover Sheet (see Appendix 1)
- Survey Area
 - Survey Unit
 - Building/Structure
 - Survey Unit/Area Description
 - Building Information – Check the appropriate block for Survey Type, Building Type Classification, and Contaminants of Concern
 - Justification for Classification – Provide a brief justification for the survey unit classification. If the survey unit is not classified (e.g. RLC Survey), enter N/A
 - Special Support Requirements – Provide a brief description as necessary
 - Special Safety Precautions – Provide a brief description as necessary
 - Isolation Controls – Identify the level of isolation controls for the survey unit/area. (Are subject to change based on radiological conditions)
 - Labeling Requirements – Provide a brief description as necessary
- [6] Enter the following information on Survey Package Survey/Sampling Instructions Form (see Appendix 7)
- Survey Area (Page 1 and 2)
 - Survey Unit (Page 1 and 2)
 - Survey Unit/Area Description (Page 1 and 2)
 - Building/Structure – Building number (Page 1 and 2)
 - Number and Type – For each measurement listed, enter the number of required measurements and type
 - Comments – Identify measurement/sample locations and any other information pertinent to the person performing the survey or collecting the samples
 - Survey/Sampling Instructions – Provide explicit step by step instructions to RCTs and Samplers to meet the requirements of this procedure
- [7] If required, input the following information on the survey maps
- Classification
 - Sample Location Number
 - Survey Area
 - Survey Unit
 - Building/Structure

- Survey Unit/Area Description
 - Direction Indicator
 - Floor Area – In square meters
 - Total Area – Total Survey Unit/Area surface area in square meters.
- [8] Enter the following information on Survey Package Correction/Change History Form (see Appendix 8):
- Survey Area.
 - Survey Unit.
 - Building/Structure
- [9] Ensure that the following forms have been prepared in accordance PRO-476-RSP-16 02, Pre-Demolition (Final Status) Surveys of Surfaces and Structures, prior to initiation of the radiological survey/sampling package.
- Total Surface Activity Data Sheet
 - Removable Activity Data Sheet
 - Instrument Data Sheet

This is for FSS only, all other surveys shall be conducted utilizing applicable RSP Section 7 series procedures

7.9 Survey/Sample Package Release

RE

- [1] WHEN the preparation of the survey/sampling package forms has been completed, THEN assemble the survey package ensuring that it contains the applicable documentation listed below:
- Survey Package Cover Sheet (see Appendix 1)
 - Survey Package Correction/Change History Form (see Appendix 8)
 - Survey Package Survey/Sampling Instructions Form (see Appendix 7)
 - Total Surface Activity Data Sheet [see PRO-476-RSP-16.02 (FSS Only)]
 - Removable Activity Data Sheet [see PRO-476-RSP-16 02 (FSS Only)]
 - Instrument Data Sheet [see PRO-476-RSP-16 02 (FSS Only)]
 - Survey Signature Sheet (see PRO-476-RSP-16.02)
 - Survey Package Calculation Worksheet [see Appendix 6 (FSS Only)]
 - Surface Media Data Form (see PRO-477-RSP-16.03), if required
 - Survey Map(s).
- [2] Print name, employee number, sign and date the survey package indicating the survey package is ready for implementation.
- [3] Forward the survey package to another RE for peer review

RE (Peer Review)

- [4] Review the survey package prior to implementation and verify that all survey package information is complete and correct
- [5] After completion of review print name, employee number, sign and date the survey package indicating the survey package is ready for implementation and forward to RE

RE

- [6] Enter the following information on Survey Package Tracking Form (see Appendix 4)
 - Initial and date the Initiator/Date block
 - Enter the release date in the Release Date block

7 10 Survey/Sample Package Implementation

RE

- [1] Prior to implementing a survey package, interface with facility personnel, to ensure that special support requirements and safety precautions are in place
- [2] Before issuing a survey package for the performance of a final status survey, inspect the survey unit and verify that special support requirements and special safety precautions are in place
- [3] Verify for final status survey that isolation controls are in place and appear to have remained in effect continuously, prior to issuing the survey package
- [4] **IF** the survey unit is **NOT** ready for the performance of a final status survey, **THEN** notify the appropriate authority to commence corrective actions
- [5] Forward survey packages to RCTTS for the performance of final status surveys in accordance with PRO-476-RSP-16 02, Pre Demolition (Final Status) Surveys of Surfaces and Structures and PRO-477-RSP-16 03, Radiological Samples of Building Media

7 11 Survey/Sample Data Review

RCT

- [1] Complete for Final Status Surveys all survey forms in accordance with PRO-476-RSP-16.02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures, and PRO-477-RSP-16.03, Radiological Samples of Building Media.
- [2] Forward the survey package to the Radiological Control Technical Supervisor

RCTTS

- [3] Review all documentation for completion and ensure all surveys and samples are accounted for
- [4] Provide any necessary comments, print name, employee number, sign and date survey form
- [5] Forward the survey package to the appropriate Radiological Engineer

RE

- [6] Verify survey data meets the survey instruction requirements outlined on Survey Package Survey/Sampling Instruction Form (see Appendix 7).
- [7] Provide any necessary comments, print name, employee number, sign and date Survey Package Survey/Sampling Instruction Form.

7 12 Additional Survey Requirements

RE

NOTE FSS action levels are delineated in Table 5, Impacted Class 1 and 2 Survey Unit Investigations and Table 6, Impacted Class 1 Survey Unit Investigations. If these action levels are exceeded the following steps (FSS Only) need to be performed.

- [1] Prior to performing the investigations described in the tables, the following should be performed by a qualified Radiological Engineer with final survey experience using Site procedures, if applicable.
 - [A] Evaluate if the original result is accurate and representative of the radiological state of the area (i.e., the original result was not a false positive)
 - [B] Evaluate if the elevated result is due to DOE-Added material versus naturally occurring radioactive material (NORM, e.g., radon or radon progeny).

- [C] Investigate the origin of the contamination (i.e., legacy or the result of D&D activities) in order to determine the appropriate follow-up actions
- [D] Assure that a pattern of contamination does not exist by reviewing other survey/sample results (especially applicable to media samples)

Table 5
Impacted Class 1 and 2 Survey Unit Investigations

Condition	Follow-up Actions ¹
1) Any total surface activity or media sample result taken exceeds the DCGL _{EMC}	1) Remediate and re-survey
2) Any scan result exceeds 75% of the DCGL _{EMC}	2) Perform a total surface activity measurement at the flagged area to assure the actual value is less than the DCGL _W . If the follow up total surface activity measurement exceeds the DCGL _W then collect eight (8) additional measurements within a m ² to ensure the average is less than the DCGL _W . If not the area must be remediated
3) The average value for total surface activity or media samples results for the survey unit exceeds the DCGL _W	3) Assure the initial survey design is appropriate. Adjust survey design as necessary. Remediate and/or re survey
4) Any single TSC/Media Result exceeds the applicable DCGL _W but is less than the DCGL _{EMC}	4) Collect eight (8) additional measurements/samples within a m ² to ensure the average is less than the DCGL _W
5) Any single removable activity result exceeds the applicable DCGL _W	5) Remediate and re survey

¹Reclassification and re survey may not be necessary if the contamination can be attributed to a known D&D activity. For this case the area of potential contamination can be readily identified and remediated

Table 6
Impacted Class 3 Survey Unit Investigations

Condition	Follow-up Actions ¹
1) Any total surface activity or media sample result exceeds the DCGL _w	1) Reclassify and re-survey.
2) Any scan result exceeds 75% of the DCGL _{EMC}	2) Perform a total surface activity measurement at the flagged area to assure the actual value is less than the DCGL _w . If the follow-up total surface activity measurement exceeds the DCGL _w then, collect eight (8) additional measurements within a m ² to ensure the average is less than the DCGL _w . If not, the area must be remediated, re-classified, and re-surveyed.
3) The average value for total surface activity or media sample results for the survey unit exceeds 75% of the DCGL _w	3) Reclassify and re-survey (remediation may also be required).
4) Any single removable activity result exceeds 75% of the DCGL _w	4) Remediate, reclassify and re-survey.

¹Reclassification and re-survey may not be necessary if the contamination can be attributed to a known D&D activity. For this case, the area of potential contamination can be readily identified and remediated.

The above methodology SHALL be utilized to meet the intent of DOE Order 5400.5. The intent is that the average of values for total activity/media samples cannot exceed 100 dpm per 100 cm² over 1 m² (versus collecting data for every square meter in the survey unit), provided that no single measurement exceeds the DCGL_{EMC} of 300 dpm/100 cm².

- [2] IF an investigation is required,
THEN initiate Scan Survey/Investigation Documentation Form (see PRO-476-RSP-16 02)
- RCT
- [3] Perform an investigation survey per the direction of the Radiological Engineer in accordance with PRO-476-RSP-16.02
- [4] After completing the survey and logging all results, conduct an initial review and forward the completed form to the Radiological Engineer for review
- RE
- [5] Review the form for completeness and correctness, print name, employee number, sign and date

- [6] IF additional remediation and investigation surveys are required
THEN forward the package to the RE to complete the steps in Section 7 13 as appropriate

7 13 Survey/Sample Package Validation, Data Quality Analysis and Closure

RE

NOTE *The following Steps 7 13[1] through 7 13[15] are for Reconnaissance Level Characterization only*

- [1] Review all survey package data to verify it meets the intent of the DQOs and survey design
- [2] Conduct a preliminary review of all survey package data to verify that all measurements are reported in the required units (dpm/100 cm²)
- [3] Verify that all survey package data meets the Representativeness Comparability and Completeness requirements delineated in the RLCP
- [4] IF any discrepancies are noted
THEN initiate corrections/changes in accordance with Section 7 14 of this procedure
- [5] IF no discrepancies are noted
OR the discrepancies have been corrected,
THEN print name employee number, sign and date Survey Package Cover Sheet (see Appendix 1) indicating the survey package is ready for closure
- [6] Forward the survey package to the designated reviewer for final validation and closure

RE (reviewer)

- [7] Verify that all survey data satisfies RLC acceptance criteria
- [8] IF any discrepancies are noted
THEN notify the RE to initiate corrections/changes in accordance with Section 7 14 of this procedure
- [9] IF no discrepancies are noted
OR the discrepancies have been corrected,
THEN enter the validation date on Survey Package Tracking Form (see Appendix 4) indicating that the survey package results have been validated
- [10] Print name employee number sign and date Survey Package Cover Sheet indicating the survey package is ready for closure

- [11] Return the survey package to the RE who will forward the survey package to the RE Manager or RSM

RE Manager or RSM

- [12] Verify that all survey data satisfies RLC acceptance criteria and print name, employee number, sign and date Survey Package Cover Sheet indicating the survey package is ready for closure

- [13] Forward the completed survey package to the RE

RE

- [14] Enter the closure date on Survey Package Tracking Form indicating that the survey package is closed

- [15] Forward the closed survey package to Records for storage.

NOTE *The following Steps 7 13[16] through 7 13[28] are for Final Status Survey only*

- [16] Review all survey package data in accordance with PRO-478-RSP-16 04, Radiological Survey/Sample Data Quality Analysis for Final Status Survey

- [17] IF any discrepancies are noted
THEN initiate corrections/changes in accordance with Section 7 14 of this procedure

- [18] IF no discrepancies are noted
OR the discrepancies have been corrected,
THEN print name, employee number, sign and date Survey Package Cover Sheet indicating the survey package is ready for closure

- [19] Forward the survey package to the designated reviewer for final validation and closure

RE (reviewer)

- [20] Verify that all survey data satisfies FSS acceptance criteria.

- [21] IF any discrepancies are noted
THEN notify the RE to initiate corrections/changes in accordance with Section 7 14 of this procedure

- [22] IF no discrepancies are noted
OR the discrepancies have been corrected,
THEN enter the validation date on Survey Package Tracking Form indicating that the survey package results have been validated.

-
- [23] Print name, employee number, sign and date Survey Package Cover Sheet indicating the survey package is ready for closure
- [24] Return the survey package to the RE who will forward the survey package to the RE Manager or RSM

RE Manager or RSM

- [25] Verify that all survey data satisfies FSS acceptance criteria and print name, employee number, sign and date Survey Package Cover Sheet indicating the survey package is ready for closure
- [26] Forward the completed survey package to the RE

RE

- [27] Enter the closure date on Survey Package Tracking Form indicating that the survey package is closed
- [28] File the closed survey package in a cabinet for final status survey report generation

7 14 Survey/Sample Package Administrative/Technical Change Process

Changes to radiological survey/sampling package are categorized as administrative or technical. This guideline applies to all changes made to radiological survey/sample packages and all supporting documentation.

7 14 1 Administrative Changes

Administrative changes include, but are not limited to, corrections/changes that

- Do not alter the number of data points collected
- Are typographical errors
- Result in changes to the radiological survey/sampling package name, number and/or survey unit description
- Do not impact Radiochemistry lab results or documentation
- Do not modify the original design of survey units or specific survey instructions contained in the survey package

Administrative changes to radiological survey/sampling package instructions or supporting documentation are allowed without additional review and approval in accordance with the following:

Change Initiator

- [1] **IF** the change is performed on a hard copy
THEN draw a single line through the information to be changed and initial and date the correction/change

- [2] IF the change is performed electronically,
THEN re-enter the change, and add the new page directly into the radiological
survey/sampling package

The page shall have the same page number as the original page. The page(s)
being replaced shall be annotated or stamped "Superseded", initialed and dated
The superseded page(s) shall be retained in the radiological survey/sampling
package then discarded after radiological survey/sampling package closure

- [3] IF the change results in the addition of one or more new pages to the radiological
survey/sampling package,
THEN the new page(s) shall be numbered with the original page number and an
alpha designator

Example: Additional Pages for Administrative Changes

If a page were added to the original Page 1 of 20, the added page would be Page
1a of 20. If more pages are added, the added pages would be 1b of 20,
1c of 20, etc

7.14.2 Technical Changes

Technical changes are corrections/changes identified during execution/review that
requires modifications to the initial design of the radiological survey/sampling package or
survey instructions

Technical changes include, but are not limited to:

- Reclassification of a survey unit.
- Additional survey instructions that are added to the radiological survey/sampling
package after initiation
- Significant changes to the radiological survey/sampling package or major changes in
the initial radiological survey design.
- Survey instruction clarification
- Detector types and/or count times
- Grid requirements
- Isolation Controls.
- Special Support Requirements and Special Safety Precautions.

Change Initiator

- [1] IF the change is performed on a hard copy,
THEN draw a single line through the information to be changed initial and date
the correction/change and enter the correction/change number (e g Change #1)
- [2] IF the change is performed electronically,
THEN re-enter the change and add the new page directly into the survey package

The page shall have the same page number as the original page The page(s)
being replaced shall be annotated or stamped "Superseded", initialed and dated
and the correction/change number entered (e g Change #1) The superseded
page(s) shall be retained in the survey package then discarded after survey
package closure

- [3] IF the change results in the addition of one or more new pages to the survey
package
THEN the new page(s) shall be numbered with the original page number and an
alpha designator

Example Additional Pages for Technical Changes

If a page were added to the original Page 1 of 20, the added page would be Page
1a of 20 If more pages are added, the added pages would be 1a of 20, 1b of 20,
1c of 20, etc

- [4] Enter the following information on Survey Package Correction/Change History
Form (see Appendix 8)
- Make the applicable correction/change in the radiological survey/sampling
package
 - Survey Area
 - Survey Unit
 - Building/Structure number
 - Change/correction number Correction/Change are numbered sequentially
starting with ' 1'
 - Provide a brief description of the correction/change
 - Initial and date the Initiator/Date column

RE

- [5] Initial the RE column to approve the correction/change

8 POST-PERFORMANCE ACTIVITY

RE

- [1] Generate a Final Report to summarize the data for given buildings/clusters or portions thereof

The report should contain a concise and organized data summary for each type of data. Individual sections should be developed to discuss the results for each data type as outlined below (results in each section should be subdivided by survey unit)

- 1 Total Surface Activity results
- 2 Removable Surface Activity results.
- 3 Media Sample results.
- 4 Scan results

9 RECORD PROCESSING INSTRUCTIONS

The following records generated as a result of this procedure should be maintained and processed as given in the table below

Record Identification	Record Type	Protection/Storage	Processing Instructions
In process Appendix 1 Survey Package Cover Sheet or equivalent Appendix 2 Survey Package Sign-Out Form or equivalent Appendix 3 Survey Unit Breakdown Form or equivalent Appendix 6 Survey Package Calculation Worksheet or equivalent Appendix 7 Survey Package Survey/Sampling Instructions Form or equivalent Appendix 8 Survey Package Correction/Change History Form or equivalent and other documentation as identified in the procedure that make up the Survey Package	In process QA Record	Responsible Manager shall implement a reasonable level of protection for in process QA records to prevent loss or degradation. Records shall be stored in standard office filing systems.	Continued prescribed processing of documents. Upon completion of processing approval and authentication records will be transmitted to appropriate Records Center (e.g. Project Records) in accordance with 1 V41 RM-001 Records Management Guidance for Records Sources.
Appendix 4 Survey Package Tracking Form or equivalent	Non-Record	None	Retain by the RE and when no longer needed the form is destroyed.
Completed Forms and documents as identified above	Completed QA Record	Responsible Manager shall implement a reasonable level of protection for QA records to prevent loss or degradation in conjunction with Site Records Management organization to assure reasonable level of controls are being implemented.	When inactive as defined in 1-V41 RM-001 Records Management Guidance for Records Sources transfer to Site Records Management for archiving in accordance with 1 V41-RM-001.

10 REFERENCES

The following documents are either directly referenced or used in the development of this procedure

Decommissioning Program Plan

DOE Order 5400.5 Radiation Protection of the Public and the Environment

MAN-076-FDPM, Facility Disposition Program Manual

MAN-077-DDCP, Decontamination and Decommissioning Characterization Protocol

MAN 127-PDSP, Pre-Demolition Survey Plan (also referred to as Site PDSP)

NRC Reg Guide 1.86, Termination of Operating Licenses for Nuclear Reactors

**NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual
(MARSSIM)**

**PRO-476-RSP-16 02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces
and Structures**

PRO-477-RSP-16 03, Radiological Samples of Building Media

**PRO-478-RSP-16 04, Radiological Survey/Sample Data Quality Analysis for Final Status
Survey**

**PRO-479-RSP-16 05, Radiological Survey/Sample Quality Control for Final Status
Survey**

Rocky Flats Cleanup Agreement (RFCA)

1-V41-RM-001, Records Management Guidance for Records Sources

3-PRO-165-RSP-07 02, Contamination Monitoring Requirements

RADIOLOGICAL SURVEY/SAMPLING
PACKAGE DESIGN, PREPARATION,
CONTROL IMPLEMENTATION
AND CLOSURE

(05/22/01)

PRO-475-RSP-16 01
REVISION 1
PAGE 35

APPENDIX 1

Page 1 of 1

SURVEY PACKAGE COVER SHEET

Survey Area	Survey Unit	Building/Structure	
Survey Unit/Area Description			
Building Information			
Survey Type Reconnaissance Level Characterization Survey <input type="checkbox"/> Final Status Survey <input type="checkbox"/>			
Building Type Type 1 <input type="checkbox"/> Type 2 <input type="checkbox"/> Type 3 <input type="checkbox"/>			
Classification Class 1 <input type="checkbox"/> Class 2 <input type="checkbox"/> Class 3 <input type="checkbox"/> Unknown <input type="checkbox"/>			
CONTAMINANTS OF CONCERN PLUTONIUM <input type="checkbox"/> URANIUM <input type="checkbox"/> OTHER <input type="checkbox"/>			
Justification for Classification			
Special Support Requirements			
Special Safety Precautions			
Isolation Controls			
LEVEL 1 <input type="checkbox"/> LEVEL 2 <input type="checkbox"/> N/A <input type="checkbox"/>			
Labeling Requirements			
Survey Package Implementation			
Radiological Engineer Printed Name			
Employee #			
Radiological Engineer Signature			
Date			
Radiological Engineer Printed Name			
Employee #			
Radiological Engineer Signature			
Date			
Comments			
Survey Package Closure			
Radiological Engineer Printed Name			
Employee #			
Radiological Engineer Signature			
Date			
Radiological Engineer Printed Name			
Employee #			
Radiological Engineer Signature			
Date			
RE Manager or RSM Printed Name			
Employee #			
RE Manager or RSM Signature			
Date			

Page ____ of ____

(05/22/01)

PAGE 36

Page 1 of 1

SURVEY PACKAGE SIGN-OUT FORM

EXAMPLE

Page ____ of ____

[illegible]

RADIOLOGICAL SURVEY/SAMPLING
PACKAGE DESIGN, PREPARATION,
CONTROL, IMPLEMENTATION
AND CLOSURE

(05/22/01)

PRO-475-RSP-16 01
REVISION 1
PAGE 38

APPENDIX 4

Page 1 of 1

SURVEY PACKAGE TRACKING FORM

Survey Area	Survey Unit	Initiator/Date	Release Date	Validation Date	Closure Date						
EXAMPLE											

Page ___ of ___

(05/22/01)

APPENDIX 5

Page 1 of 3

DEFAULT CALCULATION WORKSHEETS

Total Surface Activity Measurement Calculation Worksheet (Default Values to be Utilized when Minimal to No Characterization Data is Available)	
Step 1	Determine the relative shift (Δ/σ) in accordance with MARSSIM Section 5.5.2.3 as follows $\Delta/\sigma = (DCGL_{TSA} - LBGR_{TSA}) / SD_{TSA}$ $\Delta/\sigma_{transuranics} = 2.0 = (100 \text{ dpm}/100\text{cm}^2 - 40 \text{ dpm}/100\text{cm}^2) / 30 \text{ dpm}/100\text{cm}^2$ Where Δ/σ is the relative shift or the resolution of measurements in units of measurement uncertainty (MARSSIM recommends a value between 1 and 3) $DCGL_{TSA}$ is the total surface activity derived concentration guideline value (DOE Order 5400.5 total surface activity limit equals 100 dpm/100cm ² for transuranics per the B779 Cluster Radiological Closeout Survey Plan) $LBGR_{TSA}$ is the lower bound of the gray region – the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor. The $LBGR_{TSA}$ was adjusted to obtain a relative shift between 1 and 3 (i.e. 40 dpm/100cm ² for transuranics) SD_{TSA} is the estimated standard deviation of the total surface activity measurements (MARSSIM recommends assuming a 30% coefficient of variation if scoping or characterization data is not available)
Step 2	Determine the Sign P value by looking up the relative shift (Δ/σ) in Table 5.4 of MARSSIM (the Sign P value is the estimated probability that a random measurement from the survey unit will be less than the DCGL when the survey unit median is actually at the LBGR). The Sign P value from Table 5.4 equals 0.977250 for a relative shift of 2.0
Step 3	Determine the number of total surface activity measurements for the applicable survey unit using the following MARSSIM Section 5.5.2.3 formula that is based on Plutonium contaminants not being present in the background $N = (1.645 + 1.645)^2 / 4(\text{Sign P} - 0.5)^2$ $N = (1.645 + 1.645)^2 / 4(0.977250 - 0.5)^2 = 11.88$ Where 1.645 is the alpha and beta decision error value (95% confidence) per the PDSP Sign P equals 0.977250
Step 4	Increase N by 20% to allow for missing or invalid data points per MARSSIM Section 5.5.2.3 $N = 11.88 \cdot 1.2 = 14.25$
Conclusion A minimum of 15 Total Surface Activity measurements will be required for each survey unit(s)	

(05/22/01)

APPENDIX 5

Page 2 of 3

Removable Activity Measurement Calculation Worksheet (Default Values to be Utilized when Minimal to No Characterization Data is Available)

Step 1 Determine the relative shift (Δ/σ) in accordance with MARSSIM, Section 5.5.2.3, as follows:

$$\Delta/\sigma = (DCGL_{removable} - LBGR_{removable}) / SD_{removable}$$

$$\Delta/\sigma = 2 = (20 \text{ dpm}/100\text{cm}^2 - 8 \text{ dpm}/100\text{cm}^2) / 6 \text{ dpm}/100\text{cm}^2$$

Where:

Δ/σ is the relative shift or the resolution of measurements in units of measurement uncertainty (MARSSIM recommends a value between 1 and 3)

$DCGL_{removable}$ is the removable surface activity derived concentration guideline value (DOE Order 5400.5 removable activity limit equals 20 dpm/100cm² for transuranics)

$LBGR_{removable}$ is the lower bound of the gray region - the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor. In order to obtain a relative shift between 1 and 3 the chosen LBGR is 8 dpm/100cm² for transuranics.

$SD_{removable}$ is the estimated standard deviation of the removable surface activity measurements (MARSSIM recommends assuming a 30% coefficient of variation if scoping or characterization data is not available). Since the B729 scoping or characterization data did not contain actual values less than the MDA of the counting instrument, a value of 6 dpm/100cm² was used.

Step 2. Determine the Sign P value by looking up the relative shift (Δ/σ) in Table 5.4 of MARSSIM (the Sign P value is the estimated probability that a random measurement from the survey unit will be less than the DCGL when the survey unit median is actually at the LBGR). The Sign P value from Table 5.4, rounded conservatively equals 0.977250 for a relative shift of 2.

Step 3. Determine the number of removable activity measurements for the applicable survey unit using the following MARSSIM, Section 5.5.2.3 formula that is based on Plutonium contaminants not being present in the background:

$$N = (1.645 + 1.645)^2 / 4(\text{Sign P} - 0.5)^2$$

$$N = (1.645 + 1.645)^2 / 4(0.977250 - 0.5)^2 = 11.88$$

Where:

1.646 is the alpha and beta decision error value (95% confidence) per the PDSP
Sign P equals 0.977250

Step 4 Increase N by 20% to allow for missing or invalid data points per MARSSIM, Section 5.5.2.3

$$N = 11.88 * 1.2 = 14.25$$

Conclusion: A minimum of 15 removable activity measurements will be required in each survey unit(s).

APPENDIX 5

Page 3 of 3

**Media Surface Activity Measurement Calculation Worksheet
(Default Values to be Utilized when Minimal to No Characterization Data is Available)**

Step 1 Determine the relative shift (Δ/σ) in accordance with MARSSIM Section 5.5.2.3 as follows

Note: Since a reference area background subtract will not be used for uranium measurements and since the equation in Section 5.5.2.3 results in a larger number of samples than the equation in Section 5.5.2.1 for a relative shift of 2.0, it is acceptable to use the equation in Section 5.5.2.3 for uranium.

$$\Delta/\sigma = (DCGL_{media} - LBGR_{media}) / SD_{media}$$

$$\Delta/\sigma_{transuranic} = 2.0 = (100 \text{ dpm}/100\text{cm}^2 - 40 \text{ dpm}/100\text{cm}^2) / 30 \text{ dpm}/100\text{cm}^2$$
$$\Delta/\sigma_{uranium} = 2.0 = (5000 \text{ dpm}/100\text{cm}^2 - 2000 \text{ dpm}/100\text{cm}^2) / 1500 \text{ dpm}/100\text{cm}^2$$

Where

Δ/σ is the relative shift or the resolution of measurements in units of measurement uncertainty (MARSSIM recommends a value between 1 and 3)

$DCGL_{media}$ is the total surface activity derived concentration guideline value (DOE Order 5400.5 total surface activity limit equals 100 dpm/100cm² for transuranics and 5000 dpm/100cm² for uranium per the B779 Cluster Radiological Closeout Survey Plan)

$LBGR_{media}$ is the lower bound of the gray region – the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor. The $LBGR_{media}$ was adjusted to obtain a relative shift between 1 and 3 (i.e., 40 dpm/100cm² for transuranics and 2000 dpm/100cm² for uranium)

SD_{media} is the estimated standard deviation of the media surface activity measurements (MARSSIM recommends assuming a 30% coefficient of variation if scoping or characterization data is not available) (i.e., 30 dpm/100cm² for transuranics and 1500 dpm/100cm² for uranium)

Step 2 Determine The Sign P value by looking up the Relative Shift (Δ/σ) in Table 5.4 of MARSSIM (The Sign P value is the estimated probability that a Random Measurement from the Survey Unit will be less than the DCGL when the Survey Unit Median is actually at the LBGR). The Sign P value from Table 5.4 equals 0.977250 for a Relative Shift of 2.0.

Step 3 Determine the number of media surface activity measurements for the applicable survey unit using the following MARSSIM Section 5.5.2.3 formula that is based on Plutonium contaminants not being present in the background.

$$N = (1.645 + 1.645)^2 / 4(\text{Sign P} - 0.5)^2$$

$$N = (1.645 + 1.645)^2 / 4(0.977250 - 0.5)^2 = 11.88$$

Where

1.647 is the alpha and beta decision error value (95% confidence) per PDSP

Sign P equals 0.977250

Step 4 Increase N by 20% to allow for missing or invalid data points per MARSSIM Section 5.5.2.3

$$N = 11.88 * 1.2 = 14.25$$

Conclusion: A minimum of 15 media surface activity measurements will be required in each survey unit.

RADIOLOGICAL SURVEY/SAMPLING
PACKAGE DESIGN, PREPARATION,
CONTROL, IMPLEMENTATION
AND CLOSURE

(05/22/01)

PRO-475-RSP-16 01
REVISION 1
PAGE 42

APPENDIX 6
Page 1 of 1

SURVEY PACKAGE CALCULATION WORKSHEET

Package ID	Building		
Survey Area	Survey Unit		
Survey Unit Description			
<input type="checkbox"/> Total Surface Activity <input type="checkbox"/> Removable Surface Activity	<input type="checkbox"/> Mobile Surface Activity <input type="checkbox"/> Volumetric Surface Activity		
<p>Step 1 Calculate the relative shift Δ/σ_s.</p> <p>$\Delta/\sigma_s = (DCGL \text{ LBGR})/\sigma_s$</p> <p>$\Delta/\sigma_s =$</p> <p>where</p> <p>$\Delta/\sigma_s$</p> <p>DCGL</p> <p>LBGR</p> <p>σ_s</p> <p style="font-size: 48pt; text-align: center;">EXAMPLE</p> <p>Step 2 Determine Sign p using the calculated relative shift and Table 4. Sign p is the estimated probability that a random measurement from the survey unit will be less than the DCGL_s when the survey unit median is actually at the LBGR.</p> <p>Step 3 Determine Decision Error Percentiles for $Z_{1-\alpha}$ and $Z_{1-\beta}$ and the selected decision error levels α and β. Typical (α) and (β) values used at HFETS are 0.05 and 0.05 respectively. This yields a $Z_{1-\alpha}$ and $Z_{1-\beta}$ value of 1.645 and 1.645 respectively.</p> <p>Step 4 Calculate Number of Data Points (N) for Sign Test using the following equation.</p> $N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(\text{Sign } p - 0.5)^2}$ <p>Step 5. Increase the number of data points by 20% to ensure sufficient power of the tests and to allow for possible data losses.</p> <p>Conclusion</p>			
RE Printed Name	Employee #	RE Signature	Date
RE (Peer Review) Printed Name	Employee #	RE Signature	Date

Page ____ of ____

APPENDIX 7

Page 1 of 2

SURVEY PACKAGE SURVEY/SAMPLING INSTRUCTIONS FORM

Survey Area		Survey Unit		Building/Structure	
Survey Unit Description					
Minimum Survey/Sampling Measurement Requirements					
Measurement	Number and Type		Comments		
Surface Activity Measurements					
RE Verification					
	Print Name	Employee #	Signature	Date	
Surface Scanning	EXAMPLE				
RE Verification					
	Print Name	Employee #	Signature	Date	
Media Samples					
RE Verification					
	Print Name	Employee #	Signature	Date	

Page ___ of ___

RADIOLOGICAL SURVEY/SAMPLING
PACKAGE DESIGN, PREPARATION,
CONTROL, IMPLEMENTATION
AND CLOSURE

(05/22/01)

PRO-475-RSP-16 01
REVISION 1
PAGE 44

APPENDIX 7
Page 2 of 2

SURVEY PACKAGE SURVEY/SAMPLING INSTRUCTIONS FORM (cont)

Survey Area	Survey Unit	Building/Structure
Survey Unit Description		
Survey/Sampling Instructions		
EXAMPLE		

Page ____ of ____

